

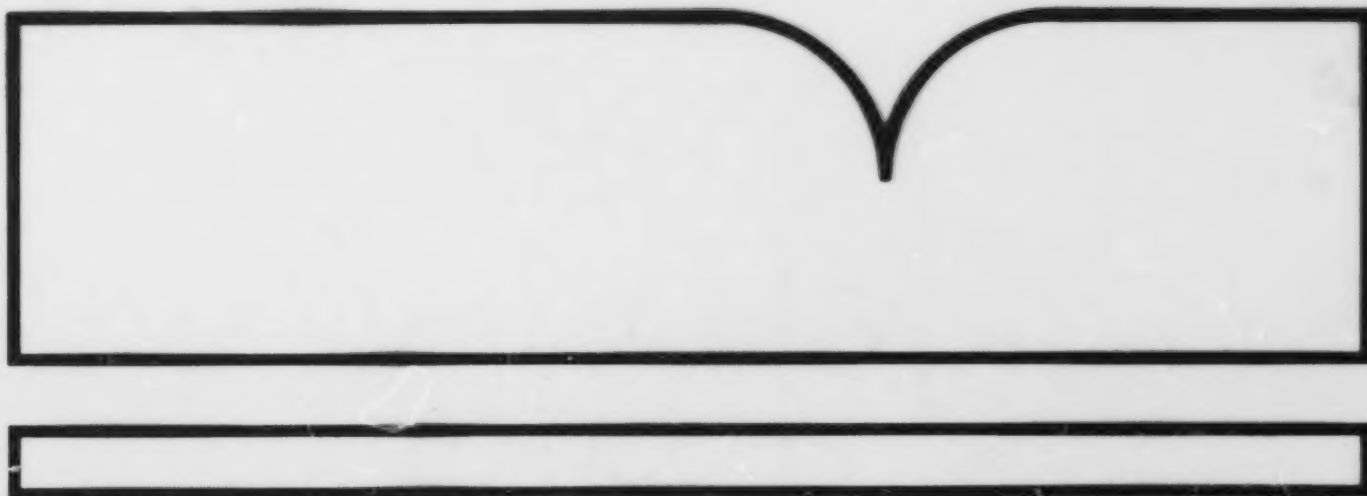
Testing Support for Evaluation of
Inspection/Maintenance Issues
(Test Group Nos. 2 and 5)

Hamilton Test Systems, Inc.
Phoenix, AZ

Prepared for

Environmental Protection Agency
Ann Arbor, MI

1979



**TESTING SUPPORT
FOR EVALUATION OF INSPECTION,
MAINTENANCE ISSUES**

(TEST GROUP NO. 2 & 5)

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16. ABSTRACT The Element II portion of Contract No. 68-03-2513 (Test Group No. 2) was performed to determine the effectiveness of the State's mandatory inspection and maintenance program. The effectiveness was to be determined by measuring the exhaust emissions of over 600 vehicles after inspection and maintenance and thereafter quarterly for a one-year period. Not all of the vehicles completed the full sequence of quarterly retests and therefore, as a continuation of that effort, this test group was established. Fifty quarterly retests were performed on twenty-two vehicles. Each retest included an Idle Test, FTP, and HFET at the HTS facility. A diagnostic check was performed on each vehicle prior to being preconditioned for the FTP. Thirty four vehicles with suspected EGR System malperformance were recruited for Test Group No. 5. The vehicles were selected based on the data from their final quarterly retest of the Element II portion of Contract No. 68-03-2513.		
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TESTING SUPPORT FOR EVALUATION
OF INSPECTION/MAINTENANCE ISSUES

(TEST GROUP NOS. 2 & 5)

by

Hamilton Test Systems, Incorporated
2303 East Thomas Road
Phoenix, Arizona 85016

Contract No. 68-03-2829

EPA Project Officer: H. Anthony Ashby

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Mobile Source Air Pollution Control
Emission Control Technology Division
Ann Arbor, Michigan 48105

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5.2 TEST GROUP NO. 2 - ELEMENT II CONTINUATION TESTS

5.2.1 SUMMARY

The Element II portion of Contract No. 68-03-2513 was performed to determine the effectiveness of the State's mandatory inspection and maintenance program. The effectiveness was to be determined by measuring the exhaust emissions of over 600 vehicles after inspection and maintenance and thereafter quarterly for a one-year period. Not all of the vehicles completed the full sequence of quarterly retests and therefore, as a continuation of that effort, this test group was established.

Fifty (50) quarterly retests were performed on twenty-two (22) vehicles. Each retest included an Idle Test, FTP, and HFET at the HTS facility. A diagnostic check was performed on each vehicle prior to being pre-conditioned for the FTP.

5.2.2 VEHICLE SELECTION & RECRUITMENT

The selection of vehicles was made by EPA and consisted of 1975 through 1977 Portland vehicles which had been recruited as replacements for original Element II cars that had dropped out of the program. Because of a contractual limit on the total number of Element II tests, it was not possible to give the replacement cars the full year's worth of quarterly tests under the original contract. The establishment of a new contract (68-03-2829) made it possible to expand the Element II data base by completing the one-year sequence of tests on the replacement cars.

Twenty-four (24) vehicles were selected for retest and all but two were recruited.

The incentives for recruitment included a \$50.00 U.S. Savings Bond, the use of a late model loan car, and a full tank of gas upon return of the participant's vehicle.

Any vehicle which required more than one quarterly retest was provided the same incentives for each retest.

5.2.3 TEST PROCEDURES

Upon completion of the owner interview which provided information for the Vehicle Maintenance Record, the vehicles were tested per the following sequence.

- Idle Test at the HTS facility (Ref. para. 4.3.1)
- Diagnostic Inspection (Ref. para. 4.3.2)
- Federal Test Procedure (FTP) (Ref. para. 4.3.3 and 4.3.4)
- Highway Fuel Economy Test (HFET) (Ref. para. 4.3.6)

5.2.4 TEST RESULTS

Since this test group was a continuation of the Element II portion of Contract No. 68-03-2513 and also to provide continuity with previous tests on these vehicles, the test results for this test group were incorporated into document EPA-460/3-79-003 "Portland Study Element II I/M Effectiveness Study".

5.3 TEST GROUP NO. 5 - EFFECTIVENESS OF EGR REPAIRS

5.3.1 SUMMARY

Thirty-four (34) vehicles with suspected EGR System malperformance were recruited for test. The vehicles were selected based on the data from their final quarterly retest of the Element II portion of Contract No. 68-03-2513.

After being rechecked to confirm the EGR malperformance, twenty-eight (28) vehicles with EGR problems were subjected to an Idle Test at the DEQ test station, followed by an Idle Test, FTP, 50 MPH Cruise test, HFET, Four Mode Test, and a Two Mode test at the HTS facility. A diagnostic check along with Propane Gain Checks were performed on each vehicle prior to being pre-conditioned for the FTP.

Maintenance was then performed on the EGR system and the vehicles were retested per the tests specified above.

The EGR systems were repaired on all but two vehicles with the following effects on FTP NO_x emissions:

- 9 Vehicles - NO_x met federal standards before and after repairs.
- 9 Vehicles - NO_x was reduced to federal standards.
- 6 Vehicles - NO_x was reduced, but still did not meet federal standards.
- 2 Vehicles - No reduction of NO_x.
- 2 Vehicles - Unable to repair EGR system.

5.3.2 VEHICLE SELECTION

The selection of thirty-eight (38) vehicles was provided by EPA and was based on the vehicles having inoperative exhaust gas recirculation (EGR) systems as reflected in their last quarterly retest of the Element II portion of Contract No. 68-03-2513.

5.3.3 VEHICLE RECRUITMENT

Thirty-four of the thirty-eight vehicles selected were recruited for the program. The incentives for recruitment included a \$50.00 U.S. Savings Bond, the use of a late model loan car, free repairs, and a full tank of gas upon return of the participant's vehicle.

Before a vehicle was accepted for test, an EGR inspection for correct operation was performed. The EGR on six (6) vehicles showed no malperformance and the vehicles were returned to the participants without any other testing.

The vehicle identification information for each of the twenty-eight (28) vehicles with inoperative EGR systems which were recruited for test is shown on Table 5.3-1. The legend for the table is as follows:

CID	-	Cubic Inch Displacement	
FS	-	Fuel Metering System	
C	-	No. of Cylinders	
WT	-	Inertia Weight	
T	-	Transmission (1 = Manual, 2 = Automatic)	
EI	-	Electronic Ignition	} 1 = Yes 2 = No
EM	-	Engine Modification	
AS	-	Air System	
CC	-	Catalytic Converter	
AHP	-	Actual Horsepower	

The first digit of the EPA number represents the model of year of the vehicle.

TABLE 5.3-1 VEHICLE IDENTIFICATION INFORMATION & AHP SETTINGS

EPA NO	VEH IDENT NO	MAKE	MODEL	CID	FS	C	WT	T	EI	AC	EM	AS	CC	AHP
33003	3P53H118273	FORD	FORD	351	2V	8	5000	2	1	1	2	2	2	14.7
33018	3K91L162431	FORD	MAVER	250	1V	6	3500	2	2	2	2	2	2	12.3
33019	3F91H517446	MERC	COUGA	351	2V	8	4500	2	2	2	2	2	2	14.0
33023	1L47R3C138596	CHEV	IMPAL	400	2V	8	5000	2	1	1	1	1	2	14.7
33031	3H30H159106	FORD	TORIN	351	2V	8	4500	2	2	1	2	2	2	14.0
33033	1D35H3Z404122	CHEV	MALIB	350	2V	8	4500	2	2	1	2	1	2	14.0
33041	LH41C3R147187	DODGE	DART	225	1V	6	3500	2	1	2	2	2	2	12.3
35030	3H42H231579	FORD	TORIN	351	2V	8	4500	2	2	2	2	2	2	14.0
35032	4Y87U3H472238	BUICK	RIVIE	455	4V	8	5500	2	2	1	2	1	2	15.3
43010	RF23G4G138132	PLYM	FURY	318	2V	8	4500	2	1	1	2	2	2	14.0
43011	4J66S103350	FORD	LTD	400	2V	8	5000	2	2	1	2	1	2	14.7
43014	4X12Y247387	FORD	PINTO	140	2V	4	3000	2	2	1	2	1	2	10.3
45026	4K91L141825	FORD	MAVER	250	1V	6	3500	2	2	1	2	1	2	12.3
54012	3J57K5M234564	OLDS	CUTLA	350	4V	8	5000	2	1	1	2	2	1	14.7
54016	5G21S176991	FORD	ELITE	400	2V	8	5000	2	1	1	2	1	1	14.7
54025	VP41C5F177306	PLYM	VALIA	225	1V	6	3500	2	1	1	1	2	1	12.3
54040	5R11Y126528	FORD	PINTO	140	2V	4	3000	1	1	2	2	1	2	10.3
54041	5G21H141408	FORD	ELITE	351	2V	8	5000	2	1	1	2	1	1	14.7
56031	5J64S139337	FORD	LTD	400	2V	8	5000	2	1	1	2	1	1	14.7
64007	6G25H142357	FORD	TORIN	351	2V	8	4500	2	1	2	2	1	1	14.0
64022	6W81F184253	FORD	GRANA	302	2V	8	4000	2	1	1	2	1	1	13.2
64047	6W81L160102	FORD	GRANA	250	1V	6	4000	2	1	1	2	1	1	13.2
66014	A6A0B7E210549	AMC	HORNT	232	1V	6	3000	2	1	1	2	2	2	11.3
74012	HLB210926812	DATSU	B210	085	2V	4	2250	1	2	2	2	1	2	8.8
74020	HH45G7G118892	PLYM	VOLAR	318	2V	8	4000	2	1	1	2	1	1	13.2
74025	HL45G7B185768	PLYM	VOLAR	318	2V	8	4000	2	1	2	2	1	1	13.2
76013	7W82L151936	FORD	GRANA	250	1V	6	4000	2	1	2	2	1	1	13.2
76014	1C29U7Z402049	CHEV	MALIB	305	2V	8	4000	2	1	1	2	2	1	11.3

5.3.4 TEST PROCEDURES

5.3.4.1 Initial Test Sequencing

After an initial check of the EGR to determine that it was still inoperative, the vehicle was tested per the following sequence:

- Idle Test at the DEQ test station (Ref. para. 4.3.1)

Note

If the vehicle failed the DEQ test, it was taken to a local repair facility by an HTS employee. The facility was told to adjust the vehicle to pass the DEQ test. Instructions were given to limit repairs to simple parts replacement (e.g. filters, plugs, wires, ignition parts).

- Idle Test at the HTS test facility (Ref. para. 4.3.1)
- Diagnostic Inspection (Ref. para. 4.3.2)
- Federal Test Procedure (FTP) (Ref. para. 4.3.3 and 4.3.4)
- 50 MPH Cruise Test (Ref. para. 4.3.8)
- Highway Fuel Economy Test (HFET) (Ref. para. 4.3.6)
- Four Mode Test (Ref. para. 4.3.9)
- Two Mode Test (Ref. para. 4.3.7)
- Propane Gain Checks (Ref. para. 4.3.10)

The Propane Gain Checks were performed in three different conditions with the vehicle in neutral gear. The conditions were:

- with PCV valve in place,
- with PCV valve removed from its seat and drawing under-hood air,
- with PCV valve in place and the fresh air hose in the induction (PCV) system removed at the air cleaner.

Vehicles with automatic transmissions were also checked in the Drive gear per the above three conditions.

5.3.4.2 EGR Repairs and Retest

After the EGR malfunction was repaired, each vehicle was retested per the initial test sequence including the Idle Test at the DEQ test station.

5.3.4.3 Shift Speeds and Horsepower Settings

Vehicles with manual transmissions were shifted at 15, 25 and 40 miles per hour.

The actual horsepower settings used for the FTP and HFET are shown on Table 5.3-1.

5.3.5 TEST RESULTS

The DEQ and HTS Idle Test results are shown on Table 5.3-2. One vehicle, EPA No. 56031, failed the DEQ Idle Test for excessive hydrocarbons and was not repaired prior to being tested because it would require major engine work.

The test results for the Two Mode & 50 MPH Cruise Tests, the Four Mode Test, and the FTP & HFET are shown on Tables 5.3-3, 5.3-4, and 5.3-5 respectively.

The maintenance performed on each vehicle and comments regarding the effectiveness of the repairs are presented on Table 5.4-6.

The results of the Propane Gain Checks are shown on Table 5.4-7.

The legend for Table 5.3-5 (FTP & HFET) is as follows:

- HC - Hydrocarbon Emissions in Grams per Mile
- CO - Carbon Monoxide Emissions in Grams per Mile
- CO₂ - Carbon Dioxide Emissions in Grams per mile
- NO_x - Oxides of Nitrogen (uncorrected) Emissions in Grams per Mile
- NO_xC - Oxides of Nitrogen Emissions Corrected for Humidity in Grams per Mile
- MPG - Miles per Gallon Calculated by the Carbon Balance Method

The legend for Tables 5.3-2, 5.3-3, and 5.3-4 (Short Tests) is as follows:

CO	- Carbon Monoxide in Percent
HC	- Hydrocarbon Emissions in ppm Hexane
RPM	- Engine Idle RPM
NO _x	- Oxides of Nitrogen in ppm
1ST	- Initial Idle Test
2500	- High Idle Test
2ND	- Second Idle Test
GARAGE	- Measurements performed with "Garage" analyzer
LAB	- Measurements performed with Laboratory analyzers (HC in ppm total hydrocarbons.)

TABLE 5.3-2 DEQ & HTS IDLE TESTS

EPA NO	DEQ IDLE TEST						HTS IDLE TEST						RPM			
	HC			CO			HC			CO			NOX		1ST	
	1ST	2ND	2ND	1ST	2ND	2ND	1ST	2ND	2ND	1ST	2ND	2ND	1ST	2ND	1ST	2ND
33003	120	45	65	1.4	.4	1.0	100	1000	110	40	100	.9	.6	.8	120	970
33003	155	90	120	.9	.9	.9	1050	1050	150	50	160	1.1	.6	.9	100	860
33018	60	75	75	1.7	2.1	3.2	950	950	80	60	80	2.0	3.1	2.4	130	860
33018	75	65	75	2.2	2.1	2.1	900	900	80	30	60	.5	1.1	.6	110	830
33019	60	45	60	.3	.3	.3	800	800	170	60	180	.4	.5	.5	100	710
33019	100	65	135	1.7	.2	1.8	800	800	120	30	90	.4	.4	.6	90	720
33023	30	25	60	.1	.1	.1	800	800	60	20	50	.1	.1	.1	60	770
33023	35	85	230	.1	.2	.1	800	800	160	50	100	.1	.1	.1	60	780
33031	105	70	125	.5	.5	.7	700	700	100	50	120	.9	.4	.6	90	630
33031	150	65	165	.3	.1	.3	700	700	190	40	130	.3	.2	.5	60	580
33033	20	20	40	.2	.3	.1	900	900	50	20	50	.1	.2	.1	80	800
33033	15	25	75	.1	.1	.1	1000	1000	20	10	20	.3	.2	.3	90	1020
33041	90	55	160	2.2	.4	2.2	800	800	130	50	130	3.3	.2	2.9	160	730
33041	100	125	155	2.2	.6	1.8	650	650	190	60	160	2.8	.2	3.1	130	690
35030	195	110	600	.1	1.9	.2	650	650	250	130	210	1.8	.8	2.1	190	780
35030	205	45	365	2.5	1.7	2.3	650	650	360	90	270	1.9	1.4	2.6	140	640
35032	30	45	35	.1	.7	.2	900	900	20	10	50	.1	.1	.1	60	770
35032	30	30	80	.2	.1	.2	800	800	80	30	40	.2	.4	.2	60	710
43010	65	50	45	.3	.2	.3	900	900	100	30	60	.2	.3	.2	100	760
43010	45	55	55	.9	.4	.6	1000	1000	90	40	40	.3	.2	.3	100	790
43011	125	35	225	.8	.2	.9	650	650	130	20	130	3.8	.2	3.4	100	680
43011	15	55	20	.5	.5	.4	1100	1100	10	10	0	.5	.4	.5	60	80
43014	20	20	30	.4	.5	.4	1250	1250	20	20	20	.5	.5	.5	60	140
45026	20	20	20	.1	.9	.1	1000	1000	60	30	30	.5	1.3	.4	140	310
45026	30	25	75	.5	.3	.7	1000	1000	20	50	20	.2	1.6	.2	140	250
54012	85	90	115	.0	.0	.0	800	800	130	30	130	.0	.0	.0	80	350
54012	55	80	65	.0	.0	.0	850	850	120	300	90	.0	.0	.0	110	720

TABLE 5.3-2 DEQ & HTS IDLE TESTS

EPA NO	DEQ IDLE TEST						HTS IDLE TEST						RPM								
	HC			CO			RPM			HC			CO			NOX		RPM			
	1ST	2500	2ND	1ST	2500	2ND	1ST	2ND	2500	1ST	2500	2ND	1ST	2500	2ND	1ST	2500	2ND	1ST	2ND	
54016	40	390	145	.3	.2	.4	700	700	10	50	.1	.0	.1	90	220	100	730	760			
54016	160	80	160	.0	.0	.0	750	750	230	30	100	.1	.0	.1	60	120	60	710	760		
54025	45	40	75	.4	.1	.5	750	750	110	50	80	1.2	.1	.6	180	1060	190	800	800		
54025	75	40	85	.1	.1	.1	800	800	50	30	70	.1	.1	.0	140	620	150	730	750		
54040	30	45	40	.1	.6	.1	850	1050	30	20	30	.1	.4	.1	60	140	60	850	1000		
54040	40	30	40	.1	.1	.1	800	800	30	20	40	.2	.2	.1	70	120	70	870	860		
54041	35	20	60	.6	.3	.5	800	800	20	10	30	.7	.3	.6	90	250	100	830	860		
54041	30	20	55	.5	.3	.5	800	800	40	10	30	.8	.0	.6	90	280	100	770	830		
56031	755	175	700	.6	.1	.7	800	800	680	140	750	.9	.0	.8	100	320	110	760	770		
56031	740	295	630	.6	.1	.8	650	650	940	110	770	.6	.0	.8	90	160	100	740	770		
64007	45	45	55	.3	.3	.3			100	20	90	.1	.1	.1	80	330	80	840	850		
64007	65	60	50	.1	.1	.1	900	900	90	90	130	.1	.1	.1	110	160	100	910	890		
64022	135	35	75	.0	.0	.0	1050	1050	160	30	100	.4	.0	.0	140	430	120	990	1040		
64022	230	105	200	.0	.0	.0	1000	1000	270	70	130	.0	.0	.0	100	120	110	980	980		
64047	120	90	90	.4	1.4	.2	800	800	110	80	90	.3	1.2	.2	70	310	80	740	780		
64047	190	140	230	1.4	.4	1.0	900	900	60	100	70	.0	1.8	.0	100	200	100	760	750		
66014	60	70	100	.4	1.3	.6	800	800	90	60	90	.6	1.4	.7	180	680	200	710	730		
66014	40	60	105	.2	.4	.1	800	850	80	30	60	.5	.7	.1	200	770	170	730	680		
74012	70	60	265	1.1	.3	1.4	800	800	160	50	120	1.9	.4	1.2	80	100	60	950	940		
74012	85	45	90	.5	.1	.4	800	800	180	50	110	.4	.2	.4	40	200	40	1050	1090		
74020	30	25	40	.0	.0	.0	750	750	30	20	30	.1	.0	.0	140	680	120	900	690		
74020	20	25	30	.0	.1	.0	850	850	60	40	50	.0	.0	.0	100	400	10	680	700		
74025	20	30	35	1.0	.0	.0	1250	1250	50	10	40	.3	.0	.3	120	480	120	1190	1080		
74025	45	25	40	.0	.0	.0	1050	1050	50	10	30	.3	.0	.0	140	500	160	1080	1030		
76013	30	30	45	.0	.1	.0	1400	1400	60	100	20	.0	.6	.0	140	130	160	790	810		
76013	105	110	110	.0	1.4	.0	650	650	70	160	150	.0	3.5	.0	120	560	110	640	720		
76014	45	15	55	.0	.1	.0	650	650	50	10	30	.0	.0	.0	110	370	110	610	590		
76014	30	40	35	.0	.1	.0	600	600	30	30	30	.0	.0	.0	80	200	90	580	540		

TABLE 5.3-3 TWO MODE & 50MPH CRUISE TESTS

EPA NO	TWO MODE				50MPH CRUISE			
	LAB	CO	NOX	HC	LAB	CO	NOX	HC
33003	1317	.4	536	90	1849	.4	2009	120
33003	1148	.2	629	100	1531	.3	1729	100
33018	1893	2.5	306	100	1867	2.2	722	90
33018	983	.7	534	60	1320	1.1	759	70
33019	809	.2	301	40	1115	.3	1119	50
33019	815	.2	289	40	1219	.4	1104	60
33023	849	.5	627	70	442	.2	1088	50
33023	797	.5	574	70	472	.2	1069	60
33031	3153	.1	521	260	947	.1	1439	60
33031	2773	.1	531	300	1069	.2	1654	80
33033	1182	.4	825	60	433	.3	1167	30
33033	1078	.5	806	60	794	.2	1284	40
33041	1461	.1	1709	1000	1167	.2	2400	60
33041	1338	.1	968	90	1240	.1	1221	80
35030	1072	.2	401	50	1711	.5	1379	90
35030	929	.1	202	70	3520	.4	701	180
35032	509	.7	331	50	151	.3	584	20
35032	509	.4	216	50	301	.2	364	60
43010	1990	.2	1743	140	1317	.2	2391	80
43010	1962	.3	1857	100	1213	.1	1002	60
43011	277	.1	335	40	647	.4	395	50
43011	5410	.1	371	420	518	.1	1048	2000
43014	475	.8	498	50	460	.6	854	60
43014	473	.9	483	40	274	.4	643	20
45026	2066	3.3	316	110	1929	1.3	1327	120
45026	2703	1.1	509	380	2439	1.9	806	120
54012	249	.0	1343	40	188	.0	1788	20
54012	463	.0	485	60	154	.0	459	20

TABLE 5.3-3 TWO MODE & 50MPH CRUISE TESTS

TABLE 3.3-3 TWO MODELS 50MPH CRUISE													
EPA NO	TWO MODE						50MPH CRUISE						
	LAB			GARAGE			LAB			GARAGE			
	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	
54016	99	.0	356	10	.0	286	.1	122	20	.1	179	.0	911
54016	90	.0	134	20	.0	326	.0	98	40	.1	130	.0	378
54025	950	.1	2401	90	.1	478	.1	194	60	.1	665	.1	2401
54025	1014	.1	2291	80	.1	417	.0	192	40	.0	530	.1	2401
54040	329	.1	486	40	.2	384	.1	80	40	.1	212	5.8	572
54040	341	.1	279	20	.1	601	.1	80	20	.1	222	.1	10
54041	393	.7	210	30	.7	393	.5	48	40	.5	225	.3	645
54041	460	.7	117	30	.6	384	.5	48	40	.4	185	.1	332
56031	518	.0	351	40	.1	4443	.7	57	425	.6	375	.1	52
56031	78	.0	379	20	.0	4844	.7	75	500	.6	246	.1	351
64007	717	.1	725	60	.1	980	.1	106	100	.1	656	.2	1693
64007	632	.1	461	60	.0	1054	.1	174	100	.1	785	.1	614
64022	895	.0	1311	110	.0	766	.0	328	110	.0	598	.1	1607
64022	904	.0	328	100	.0	1219	.0	113	160	.0	607	.0	424
64047	1947	1.4	725	140	1.5	534	.0	92	70	.0	423	.0	1394
64047	3090	2.3	1186	200	2.2	1559	.3	113	110	.2	2798	1.1	1956
66014	1476	.4	1805	60	.2	1253	.5	1485	60	.4	1136	.2	1948
66014	1314	.3	64	80	.3	711	.1	105	40	.1	953	.2	844
74012	1109	.2	976	80	.2	619	.4	68	60	.4	1292	.3	1614
74012	1256	.2	806	100	.2	1341	.2	75	140	.2	1295	.3	1643
74020	1519	.1	1315	100	.1	421	.0	143	40	.0	148	.0	1776
74020	745	.0	932	60	.0	216	.0	98	30	.0	182	.0	853
74025	145	.0	736	20	.0	130	.0	103	20	.0	225	.0	1291
74025	188	.0	1040	20	.0	188	.0	86	20	.0	151	.0	999
76013	2901	1.7	813	220	1.8	1035	.0	55	180	.0	977	.6	339
76013	2880	1.6	927	200	1.5	1344	.2	146	140	.2	2271	1.2	1810
76014	124	.0	644	20	.0	298	.0	94	40	.0	65	.0	969
76014	221	.0	204	40	.0	215	.0	49	40	.0	172	.0	355

TABLE 5.3-4 FOUR MODE TEST

EPA NO	IDLE NEUTRAL						2500 RPM						IDLE NEUTRAL						IDLE IN GEAR					
	LAB			GARAGE			LAB			GARAGE			LAB			GARAGE			LAB			GARAGE		
	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
33003	5106	1.4	65	400	1.2		1129	.5	235	100	.5	1949	.7	87	140	.7	1559	.5	123	160	.5			
33003	1188	.4	106	100	.3		332	.2	247	50	.1	448	.2	369	40	.2	1103	.6	99	100	.7			
33018	3563	5.6	62	170	5.2		1743	2.6	198	60	2.6	1533	2.0	88	60	1.8	1803	2.3	76	100	2.2			
33018	1647	.2	87	140	.2		690	.8	233	60	.8	1402	.5	89	90	.5	1041	.5	116	100	.5			
33019	824	.1	40	50	.0		320	.2	294	20	.2	733	.3	48	50	.2	1124	.2	57	60	.2			
33019	772	.1	36	80	.1		378	.3	282	20	.2	723	.2	38	50	.2	855	.1	48	50	.1			
33023	2228	.1	53	250	.1		316	.1	278	50	.1	668	.1	73	100	.1	839	.1	89	80	.1			
33023	1577	.1	49	160	.1		280	.1	309	50	.1	656	.1	75	100	.1	815	.1	106	80	.1			
33031	9985	.1	24	1350	.1		3993	.1	308	200	.1	9985	.1	33	990	.1	9985	.1	19	1110	.1			
33031	9985	.1	33	2000	.1		4363	.2	380	400	.2	9985	.1	40	1690	.1	9985	.1	24	1730	.1			
33033	9425	.1	19	1000	.1		800	.1	244	80	.1	543	.1	79	40	.1	1017	.3	172	70	.3			
33033	436	.1	88	40	.1		329	.1	158	40	.1	295	.1	86	30	.1	876	.4	248	60	.4			
33041	1828	1.2	88	80	1.2		962	.2	2400	50	.2	1821	1.1	124	90	1.2	2192	1.3	155	140	1.2			
33041	1794	1.3	62	100	1.3		641	.2	330	40	.2	1925	1.6	62	100	1.5	2063	1.6	64	130	1.6			
35030	4243	3.5	48	200	3.3		1192	.3	1146	60	.2	3623	1.3	79	220	1.3	2893	.9	91	180	.9			
35030	5600	2.3	44	540	.8		2099	.4	151	180	.6	5920	2.5	51	160	.5	4670	.4	51	160	.7			
35032	7321	.1	61	770	.2		659	.2	185	100	.2	709	.1	80	80	.1	709	.1	104	80	.1			
35032	540	.1	63	60	.0		286	.1	139	50	.1	506	.1	80	80	.1	500	.1	104	80	.1			
43010	693	.4	137	50	.4		292	.2	541	40	.2	787	.4	156	60	.4	931	.3	132	70	.3			
43010	574	.2	88	40	.2		466	.2	411	30	.2	595	.1	98	30	.1	788	.2	136	50	.2			
43011	3199	1.5	41	300	1.5		243	.1	237	50	.2	2209	1.2	58	250	1.2	1580	1.7	68	130	1.7			
43011	9982	.0	49	2000	.1		3109	.1	235	2000	.1	9982	.1	61	2000	.1	9982	.1	58	2000	.1			
43014	151	.3	58	30	.3		151	.3	82	30	.3	142	.3	63	30	.3	634	1.1	68	60	1.0			
43014	274	.3	50	10	.2		191	.3	76	20	.3	148	.3	52	20	.2	537	.9	64	40	.8			
45026	423	.1	130	40	.1		2320	3.9	163	90	3.9	399	.1	113	50	.1	1164	.3	202	90	.3			
45026	304	.1	79	20	.1		1225	2.2	179	30	1.9	289	.1	88	20	.1	748	.2	150	40	.1			
54012	552	.0	57	80	.0		57	.0	167	20	.0	482	.0	62	70	.0	258	.0	124	40	.0			
54012	430	.0	45	60	.0		1742	.0	110	190	.0	424	.0	57	60	.0	158	.0	131	20	.0			

TABLE 5.3-4 FOUR MODE TEST

EPA NO	IDLE NEUTRAL						2500 RPM						IDLE NEUTRAL						IDLE IN GEAR					
	LAB			GARAGE			LAB			GARAGE			LAB			GARAGE			LAB			GARAGE		
	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
54016	757	.1	64	120	.1	136	.0	203	.0	671	.1	67	80	.1	375	.1	103	40	.1	375	.1	103	40	.1
54016	818	.0	225	100	.1	133	.0	107	.0	717	.1	60	70	.1	338	.1	93	40	.1	338	.1	93	40	.1
54025	151	.0	63	20	.0	601	.1	1148	.0	426	.0	171	60	.1	650	.1	288	80	.1	650	.1	288	80	.1
54025	965	.1	137	80	.1	1317	.1	261	.1	1096	.0	127	110	.0	1219	.1	259	110	.1	1219	.1	259	110	.1
54040	1494	.1	63	100	.2	396	.4	135	.0	313	.1	99	40	.1	723	.1	65	50	.1	723	.1	65	50	.1
54040	794	.1	40	40	.1	295	.1	98	.0	870	.1	48	50	.1	855	.1	48	60	.1	855	.1	48	60	.1
54041	433	.5	45	40	.4	118	.2	174	.0	384	.4	50	40	.4	989	1.2	57	80	1.1	989	1.2	57	80	1.1
54041	405	.5	43	40	.4	124	.2	146	.0	341	.4	48	40	.4	855	1.1	57	65	1.1	855	1.1	57	65	1.1
56031	7794	.6	52	820	.6	616	.0	275	.0	3393	.7	62	350	.8	5414	.8	55	550	.7	5414	.8	55	550	.7
56031	6694	.7	60	750	.5	546	.1	165	.0	4613	.5	60	480	.7	3523	.5	80	320	.5	3523	.5	80	320	.5
64007	1739	.1	92	160	.1	307	.1	460	.0	922	.1	99	100	.1	996	.0	142	90	.1	996	.0	142	90	.1
64007	2078	.1	64	240	.1	601	.1	148	.0	1344	.1	64	140	.1	971	.0	117	100	.0	971	.0	117	100	.0
64022	3209	.2	130	300	.2	539	.0	508	.0	969	.0	127	150	.0	809	.0	300	120	.0	809	.0	300	120	.0
64022	6551	.1	116	700	.1	971	.0	161	.0	1546	.0	132	200	.0	925	.0	288	120	.0	925	.0	288	120	.0
64047	3420	.4	106	300	.4	1499	1.6	204	.0	469	.0	61	60	.0	799	.1	135	100	.0	799	.1	135	100	.0
64047	1941	.2	118	160	.1	974	2.9	371	.0	1112	.0	108	120	.0	1103	.0	230	140	.0	1103	.0	230	140	.0
66014	1149	.4	88	50	.4	879	.6	547	.0	1109	.4	98	60	.4	1292	.4	138	90	.4	1292	.4	138	90	.4
66014	589	.1	107	20	.0	800	.7	306	.0	733	.1	86	10	.1	941	.1	153	10	.2	941	.1	153	10	.2
74012	2749	.3	41	280	.3	702	.1	104	.0	696	.3	46	70	.3	647	.3	44	60	.3	647	.3	44	60	.3
74012	2354	.2	58	200	.2	576	.1	113	.0	2173	.2	51	240	.2	1981	.2	44	200	.2	1981	.2	44	200	.2
74020	1904	.1	52	120	.1	362	.0	378	.0	292	.0	232	40	.0	274	.0	72	30	.0	274	.0	72	30	.0
74020	632	.0	52	70	.0	164	.0	299	.0	148	.0	62	20	.0	148	.0	93	20	.0	148	.0	93	20	.0
74025	283	.0	69	40	.0	41	.0	315	.0	115	.0	69	20	.0	151	.0	182	20	.0	151	.0	182	20	.0
74025	595	.2	60	40	.2	87	.0	332	.0	206	.0	74	20	.0	191	.0	153	20	.0	191	.0	153	20	.0
76013	396	.0	36	60	.0	2803	2.1	368	.0	476	.0	36	90	.0	194	.0	98	30	.0	194	.0	98	30	.0
76013	1045	.2	21	100	.2	2727	2.7	260	.0	344	.0	67	30	.0	213	.0	198	20	.0	213	.0	198	20	.0
76014	197	.0	41	40	.0	38	.0	290	.0	182	.0	65	30	.0	127	.0	65	20	.0	127	.0	65	20	.0
76014	185	.0	44	40	.0	209	.0	123	.0	218	.0	51	30	.0	145	.0	53	30	.0	145	.0	53	30	.0

TABLE 5.4-5 FTP & HFET

-FTP-										-HFET-				
EPA NO	DATE	ODOM	HC	CO	C02	NOX	NOXC	MPG	HC	CO	C02	NOX	MPG	EPA NO
33003	791220	37518	2.93	43.94	667.1	4.35	4.20	11.9	1.76	18.43	469.4	6.08	17.60	33003
33003	791221	37562	2.61	34.86	659.3	4.21	3.76	12.3	1.57	14.32	463.4	6.09	18.07	33003
33018	791219	41512	2.76	73.03	505.1	2.52	2.33	14.1	1.87	57.04	349.6	3.11	19.92	33018
33018	791220	41558	1.64	28.54	561.8	2.95	2.71	14.5	1.36	27.08	383.2	3.53	20.62	33018
33019	800103	60510	2.29	27.06	647.1	3.16	2.76	12.7	1.50	11.60	451.4	4.68	18.70	33019
33019	800104	60578	2.42	28.16	636.7	3.17	2.71	12.9	1.53	12.78	441.0	4.62	19.03	33019
33023	800103	90617	1.33	24.77	695.1	3.94	3.44	12.0	.49	6.08	500.5	5.63	17.33	33023
33023	800104	90654	1.33	23.22	697.3	4.11	3.59	12.0	.47	6.74	500.0	5.62	17.32	33023
33031	800117	70431	10.49	25.48	617.1	4.58	3.96	12.8	2.06	4.67	470.3	6.95	18.31	33031
33031	800121	70479	10.43	29.77	621.1	4.92	4.02	12.7	2.15	6.98	487.0	8.12	17.57	33031
33033	800115	67586	1.98	28.40	674.0	4.73	4.05	12.2	.54	10.47	483.2	5.29	17.69	33033
33033	800117	67630	1.81	27.58	728.5	5.54	4.69	11.4	.51	9.95	509.2	6.33	16.85	33033
33041	800114	51113	1.76	16.10	483.1	5.66	5.00	17.3	1.01	6.58	358.0	8.09	23.87	33041
33041	800116	51155	1.65	13.77	498.5	2.74	2.45	16.9	1.07	5.49	390.5	4.41	22.03	33041
35030	791212	79812	3.01	38.03	730.7	3.01	2.65	11.1	1.83	15.76	505.1	5.05	16.56	35030
35030	791214	79875	4.31	45.46	763.1	1.57	1.40	10.5	2.75	16.02	531.6	2.74	15.68	35030
35032	791219	70123	1.38	43.29	829.0	3.17	3.03	9.8	.40	14.00	597.1	3.55	14.29	35032
35032	791221	70177	1.70	28.60	845.8	2.05	1.86	9.9	.47	10.86	658.8	2.25	13.09	35032
43010	800116	58571	2.40	33.79	640.4	4.97	4.23	12.6	1.32	6.23	452.3	8.78	19.02	43010
43010	800118	58662	2.14	23.34	658.1	3.53	2.99	12.6	1.11	3.95	457.9	5.27	18.96	43010
43011	800116	65712	3.37	52.63	753.9	2.19	1.89	10.5	1.30	16.79	590.8	2.73	14.27	43011
43011	800121	65780	3.74	29.57	726.4	3.17	2.52	11.3	1.07	4.69	577.3	5.12	15.08	43011
43014	800117	28169	.99	39.06	459.8	1.73	1.43	16.9	.21	11.33	357.3	2.35	23.60	43014
43014	800118	28217	1.04	33.88	481.8	3.14	2.58	16.5	.34	12.65	370.8	3.61	22.64	43014
45026	800123	36425	2.24	52.84	541.2	2.27	1.82	14.0	1.90	45.31	367.2	3.23	19.95	45026
45026	800124	36479	2.26	49.32	582.4	2.84	2.43	13.3	1.88	44.01	383.2	3.49	19.35	45026
54012	791129	42979	.89	7.64	636.4	6.20	5.17	13.6	.17	.63	483.3	7.31	18.29	54012
54012	791130	43000	.86	6.57	642.5	2.44	2.06	13.5	.16	1.82	500.2	2.05	17.61	54012

TABLE 5.4-5 FTP & HFET

EPA NO	DATE	ODOM	FTP					HFET					EPA NO	
			HC	CO	CO2	NOX	NOXC	MFG	HC	CO	CO2	NOX		MFG
54016	800118	27830	.99	6.43	857.0	5.43	4.45	10.2	.31	1.56	622.0	7.87	14.18	54016
54016	800121	27877	1.51	11.02	913.4	2.43	2.00	9.5	.33	1.64	658.1	3.71	13.40	54016
54025	800123	49443	1.64	12.49	432.1	5.86	4.68	19.4	.53	3.31	357.8	9.03	24.32	54025
54025	800125	49484	1.49	8.46	429.6	4.63	3.83	19.8	.45	2.01	354.9	6.09	24.67	54025
54040	800125	37869	1.02	24.19	427.4	1.16	.96	18.9	.18	3.73	314.0	1.62	27.68	54040
54040	800130	37893	1.07	22.29	455.1	1.31	1.03	18.0	.17	3.73	332.0	1.65	26.21	54040
54041	791204	50023	1.16	36.19	760.3	3.02	2.78	10.8	.24	6.99	561.3	3.55	15.48	54041
54041	791206	50061	1.07	36.58	751.3	2.45	2.19	10.9	.38	5.28	555.7	2.48	15.69	54041
56031	800124	60720	3.59	25.40	887.3	4.65	3.97	9.4	.53	3.83	615.2	6.39	14.24	56031
56031	800129	60757	3.51	23.31	918.1	2.45	1.92	9.2	.52	3.45	643.9	3.08	13.62	56031
64007	800124	44086	2.11	22.51	607.3	5.68	4.65	13.7	.82	7.28	439.8	7.44	19.54	64007
64007	800125	44123	1.99	11.87	626.7	2.94	2.51	13.6	.85	3.21	441.7	3.47	19.73	64007
64022	800123	35883	1.66	5.38	555.4	2.10	1.68	15.6	.76	1.96	431.3	6.88	20.30	64022
64022	800124	35964	1.50	4.59	570.8	1.88	1.54	15.2	.75	1.10	437.5	2.00	20.08	64022
64047	800118	37442	1.43	12.00	551.9	4.90	3.94	15.4	.38	.38	458.2	7.04	19.28	64047
64047	800121	37480	3.04	38.28	503.3	4.17	3.33	15.5	1.40	21.47	408.8	6.18	19.84	64047
66014	791211	47692	1.89	24.85	420.2	5.11	4.33	19.1	.83	4.73	375.9	7.29	22.97	66014
66014	791213	47809	1.53	13.57	439.0	3.34	2.95	19.1	.80	6.14	381.2	3.26	22.54	66014
74012	791220	57837	1.04	9.60	298.8	2.16	2.00	28.0	.87	7.23	210.6	4.32	39.47	74012
74012	791221	57892	1.24	7.88	300.4	2.16	1.95	28.0	.85	5.77	208.6	4.51	40.23	74012
74020	791212	23295	1.07	8.31	554.4	5.63	4.95	15.5	.21	.24	481.8	8.10	18.37	74020
74020	791215	23355	.92	8.55	570.9	3.58	3.18	15.1	.14	.12	501.3	4.33	17.67	74020
74025	791206	38150	1.56	30.87	572.9	2.35	2.06	14.2	.24	1.65	414.4	4.46	21.23	74025
74025	791212	38207	2.29	49.33	586.7	1.44	1.28	13.2	.23	2.38	414.6	2.87	21.16	74025
76013	791206	27352	1.50	19.81	474.3	3.40	2.98	17.4	.95	15.24	385.5	3.45	21.50	76013
76013	791207	27392	2.06	24.28	487.9	4.15	3.68	16.7	1.14	16.51	384.0	5.24	21.44	76013
76014	791213	24509	.52	6.67	514.7	2.87	2.54	16.8	.06	.31	393.2	4.01	22.52	76014
76014	791214	24563	.54	4.90	521.5	1.32	1.17	16.7	.07	.38	409.3	1.52	21.62	76014

TABLE 5.4-6 EGR SYSTEM MAINTENANCE

<u>EPA NO.</u>	<u>EGR SYSTEM MAINTENANCE</u>	<u>COMMENTS</u>
33003	Replaced EGR Temperature Controlled Vacuum Valve.	10% reduction of NO _x , but still does not meet federal standards.
33018	Replaced EGR Temperature Controlled vacuum Valve.	NO _x before and after repairs met federal standards.
33019	Replaced EGR Temperature Controlled Vacuum Valve.	NO _x before and after repairs met federal standards.
33023	Removed carbon build-up at valve seat.	No improvement to NO _x after repair.
33031	Replaced EGR Temperature Controlled Vacuum Valve. (Valve location due to add-on air conditioner does not provide correct temperature for proper operation.)	No improvement to NO _x after partial repair.
33033	Removed EGR Valve and found intake manifold plugged with carbon.	Unable to repair.
33041	Removed EGR Valve and cleaned carbon from valve seat. Removed carburetor and cleaned carbon from passage under carburetor.	NO _x reduced significantly (51%).
35030	Removed blockage from EGR Vacuum Hose.	NO _x reduced (39%) to federal standards.
35032	Removed blockage and correctly rerouted Vacuum Hose.	NO _x before and after repairs met federal standards.
43010	Removed EGR Valve and cleaned carbon from valve. Removed carburetor, cleaned out EGR vacuum passage.	NO _x reduced (29%) to federal standards.
43011	Replaced EGR Temperature Controlled Vacuum Valve.	NO _x before and after repairs met federal standards.
43014	Replaced EGR Temperature Controlled Vacuum Valve.	NO _x before and after repairs met federal standards.

TABLE 5.4-6 EGR SYSTEM MAINTENANCE (cont'd)

EPA NO.	EGR SYSTEM MAINTENANCE	COMMENTS
45026	Replaced EGR Temperature Controlled Vacuum Valve.	NO _x before and after repairs met federal standards.
54012	Removed blockage from EGR Vacuum Hose.	NO _x reduced significantly (61%).
54016	Removed blockage from EGR Vacuum Hose.	NO _x reduced significantly (55%).
54025	Removed blockage from EGR Vacuum Hose.	18% reduction of NO _x , but still does not meet federal standards.
54040	Removed blockage from EGR Vacuum Hose and replaced Vacuum Delay Valve.	NO _x before and after repairs met federal standards.
54041	Removed blockage from EGR Vacuum Valve.	20% reduction of NO _x .
56031	Replaced EGR Temperature Controlled Vacuum Valve.	NO _x reduced significantly (52%).
64007	Replaced EGR Temperature Controlled Vacuum Valve and removed blockage from EGR Hose.	NO _x reduced significantly (46%).
64047	Removed blockage from EGR Hose.	15% reduction of NO _x , but still does not meet federal standards.
66014	Removed blockage from EGR Hose and replaced Vacuum Delay	32% reduction of NO _x , but still does not meet federal standards.
74012	Removed and cleaned carbon from EGR Tube that goes from exhaust manifold to EGR Valve.	NO _x before and after repairs met federal standards.
74020	Removed blockage from EGR Hose.	36% reduction of NO _x , but still does not meet federal standards.
74025	Replaced EGR Temperature Controlled Vacuum Valve.	38% reduction of NO _x .
76013	Removed blockage from EGR Hose.	NO _x increased after repairs.
76014	Removed blockage from EGR Hose.	NO _x reduced significantly (54%).

TABLE 5.3-7 PROPANE GAIN CHECKS

EPA NO	PCV IN PLACE NEUTRAL DRIVE		PCV REMOVED NEUTRAL DRIVE		PCV HOSE REM'D NEUTRAL DRIVE	
33003	170	40	200	50	140	30
33003	190	40	230	70	170	40
33018	20	DEC	60	DEC	20	DEC
33018	50	DEC	20	DEC	20	DEC
33019	130	70	170	60	110	60
33019	100	30	140	80	120	50
33023	180	70	220	90	190	80
33023	230	100	280	100	240	90
33031	130	50	120	60	100	40
33031	160	50	160	90	120	60
33033	150	40	180	50	150	40
33033	160	10	200	30	160	20
33041	DEC	DEC	70	DEC	DEC	DEC
33041	DEC	DEC	30	20	DEC	DEC
35030	30	10	20	DEC	20	DEC
35030	30	50	90	60	30	20
35032	100	30	90	40	80	30
35032	120	30	100	70	110	30
43010	220	50	230	60	180	50
43010	250	50	300	80	230	60
43011	DEC	DEC	DEC	DEC	DEC	DEC
43011	90	50	80	70	90	40
43014	DEC	DEC	60	DEC	DEC	DEC
43014	DEC	DEC	70	20	DEC	DEC
45026	240	40	200	40	240	20
45026	190	30	210	40	180	30
54012	70	10	90	40	*	*
54012	150	40	180	40	130	30

*Test not performed

DEC - Decreased

TABLE 5.3-7 PROPANE GAIN CHECKS

EPA NO	PCV IN PLACE		PCV REMOVED		PCV HOSE REM'D	
	NEUTRAL	DRIVE	NEUTRAL	DRIVE	NEUTRAL	DRIVE
54016	60	20	80	30	40	20
54016	130	50	140	80	110	70
54025	50	DEC	80	10	40	DEC
54025	130	50	160	80	110	50
54040	840	N/A	940	N/A	840	N/A
54040	800	N/A	880	N/A	770	N/A
54041	DEC	DEC	DEC	DEC	DEC	DEC
54041	DEC	DEC	DEC	DEC	DEC	DEC
56031	110	60	150	100	130	70
56031	100	80	140	90	130	70
64007	250	50	320	100	280	90
64007	200	60	300	90	240	60
64022	220	20	220	50	180	20
64022	190	40	240	60	240	60
64047	90	20	120	DEC	60	20
64047	90	20	140	30	100	20
66014	10	DEC	50	10	40	DEC
66014	80	20	130	40	70	30
74012	DEC	N/A	DEC	N/A	N/A	N/A
74012	DEC	N/A	50	N/A	N/A	N/A
74020	70	10	80	30	70	30
74020	90	20	90	40	70	30
74025	100	10	120	10	100	10
74025	170	50	180	50	170	50
76013	200	120	300	130	250	130
76013	130	20	110	30	70	10
76014	70	20	110	60	80	40
76014	*	50	110	60	80	50

* Test not performed

DEC - Decreased

N/A - Not Applicable